Whatever Happened to the Promise of Simulation Based Acquisition?

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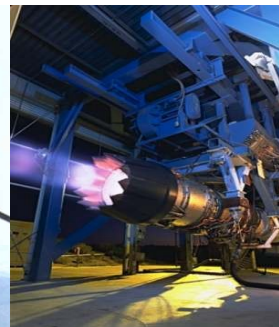


Simulation Based Acquisition

Statement of the Acquisition Council of the DoD Executive Council on Modeling and Simulation, Dec 1997

SBA Vision:

"An acquisition process in which DoD and Industry are enabled by robust, collaborative use of simulation technology that is integrated across acquisition phases and programs"

SBA Goals:

- **Substantially reduce the time, resources, and risk associated with the entire acquisition process**
- **Increase the quality, military worth and supportability of fielded systems while reducing Total Ownership Costs throughout the total life cycle**
- **Enable Integrated Product and Process Development (IPPD) across the entire acquisition life cycle**

SBA Concepts Have Been Around For 15 Years

- **Arguments for comprehensive application of M&S (88-97)**
  - Defense Science Boards; NRC, Service and industry studies
  - Commercial product development automation (CAx, PDM, etc.)
- **Aggressive cost and time goals by VP Gore's National Performance Review, OSD, and Defense Systems Affordability Council (95-97)**
- **SBA Vision statement by DoD Acquisition Council (97)**
- **Adoption by several large acquisition programs (97-01)**
  - Joint Strike Fighter, DD-21/DD(X), Crusader, FCS
- **DoD's "Road Map for SBA" (98-99)**
  - 400 pages, with architectures and 24 implementation actions
- **Conference papers and press articles (98-)**
- **International interest/initiatives (99-)**
- **Prominent mention in DoD 5000 series directives (01)**

However, the SBA "Buzz" Has Faded

- **SBA Road Map never approved**
  - Disputes about architectures, traceability, funding, …
  - Revolutionary tone offended/threatened; SBA was never adopted by most acquisition managers and systems engineers
- **No funding at the DOD/Service headquarters level**
- **Turbulence in OSD leadership of SBA**
  - Dr. Pat Sanders, Director, DTSE&E
  - Mr. John Wilson, Director, Systems Acquisition
  - Dr. V. Garber, Director of Interoperability
  - EXCIMS Acquisition Council and its working group
- **Many new leaders lack M&S expertise, missed SBA arguments**
- **2003 DoD 5000 directives have fewer references to M&S and SBA**
- **Reality of the challenges**

SBA Efforts Are Often Plagued By

- **Impatience with timeliness**
  - Lack of appreciation for up-front work required
- **Resistance to process changes**
  - Cultural issues abound
- **Suspicion of results**
  - Insufficient pedigree/traceability
  - Misunderstanding of M&S capabilities and limitations
- **Push-back from operational testers**
  - Limits on how M&S can be used
  - Suspicions about M&S validity
- **Higher costs/unclear ROI**
  - Modeling/models & simulations
  - Data acquisition
  - Data preparation
  - Validation and accreditation
  - Analysis of results, reporting
- **No measurable improvement in cost, schedule, risk, or performance**
  - No baseline for comparison
  - More complex programs may mean can only avoid increases in each

… and M&S efforts become a target for funding cuts as other program costs increase and schedules slip

Yet the Advertised Benefits are Still Desired

JSF: Multi-Role, Multi-Service, Multi-National

- ***Better informed, less risky program management***
- ***Significant cost savings through modeling and simulation***
- ***On-time, in-budget, products that meet expectations***

…and the Rationale is Still Sound

- **DoD and commercial M&S use continues to expand**
  - Many organizations and programs are pursuing SBA, albeit not necessarily by that name
  - This is empirical evidence about the value of M&S
- **New JCIDS (CJCS 3170) and DOD 5000 directives require a mission capability perspective, increasing need for a comprehensive application of M&S**
- **Business as usual, live test, and heroic efforts <u>don't scale</u> to meet development complexity and are <u>unaffordable</u>**
- **Incremental steps forward are yielding real benefits**
  - and helping us get smarter about what's needed to realize SBA

SBA Requires More Than M&S Tools

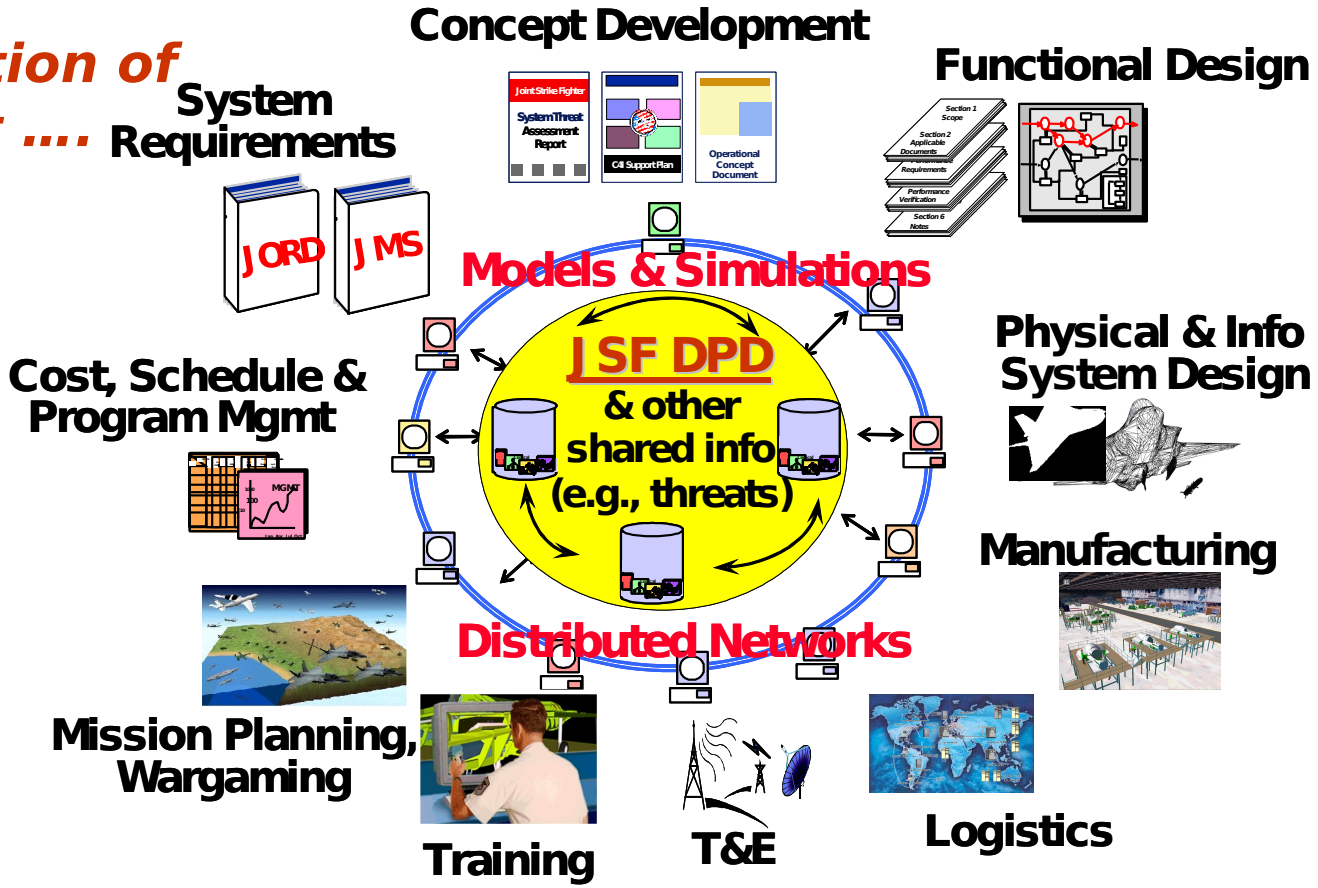
- **Revised systems engineering processes to foster life-cycle wide trade space, SoS perspective, earlier CM**
- **Contracting to allow tool & info sharing among gov't & industry, with clear responsibilities and liabilities**
- **Availability of improved models and simulations**
- **Standards to foster interoperability and reuse**
- **Competent professionals and education means**
- **Viable business model**
- **Ready access to coherent, traceable, authoritative information**

Data is Usually the Biggest Obstacle

Yes, serious cultural issues exist, but most of them involve data sharing!

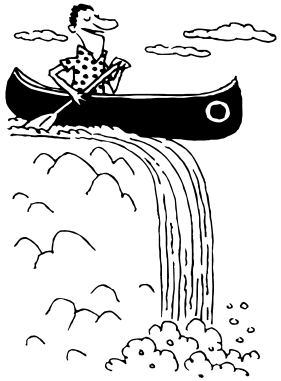
SBA Vision Recognizes That Shared Data is Key to Integrated Product Development

A digital representation of the product ….



… stored in a distributed repository to assist in defining, evaluating and managing a weapon system's entire lifecycle

Biggest Data Sharing Impediments



1. **Ignorance of reality**
   - No one knows the data flows across an enterprise
   - No one tracks the recurring costs of finding and translating data
   - Few understand the true risks of incorrect or misunderstood data

2. **Fear of exposure**
   - My failures/shortfalls will be discovered
   - My value to the organization will be diminished
   - Someone will use, or misuse, my data to attack me

3. **Misunderstood data meaning**

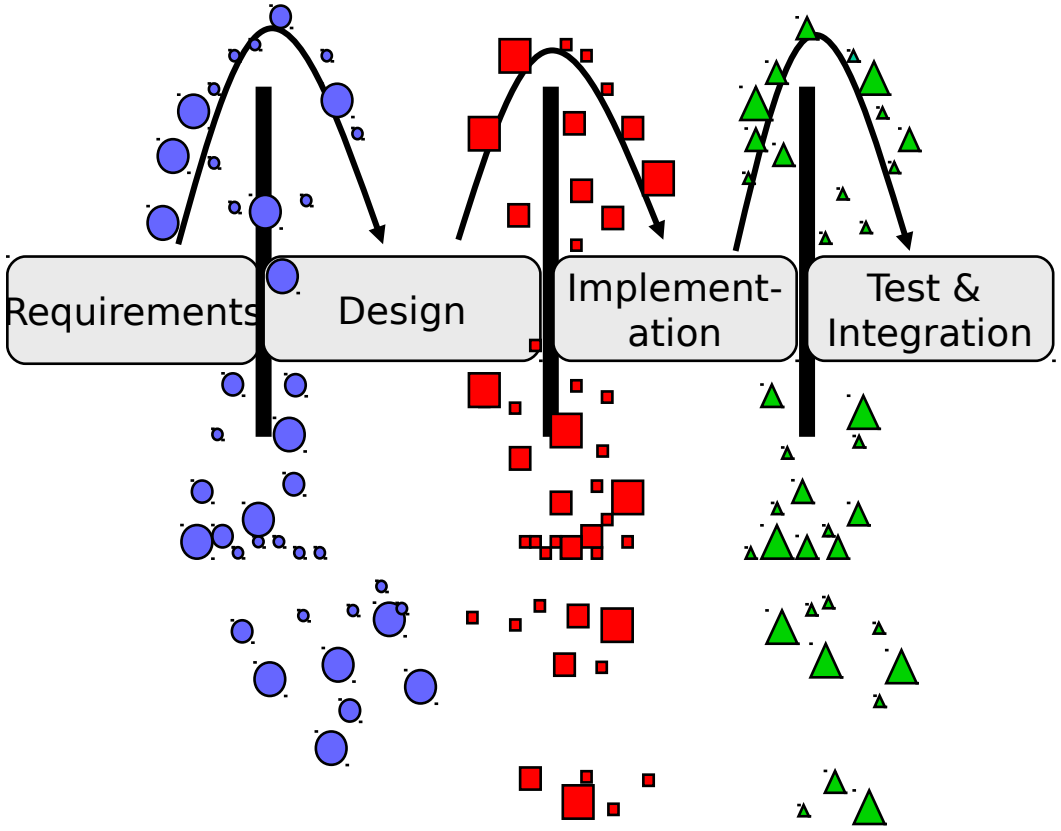
   Different disciplines/models see the world differently
   - Different abstractions = different objects, processes, attributes, actions, interactions, contexts, semantics, syntax, etc.
   - Mapping among these is problematic
   - Manually checking for coherency is impractical

1. Facing Reality:
Information Loss, Corruption and Misunderstanding Cause Rework, Cost and Schedule Overruns

BMW, VP for IT
"Many processes use the same data. At least 10% of the engineer's pay is lost searching for the right data. We need product info at a mouse click".

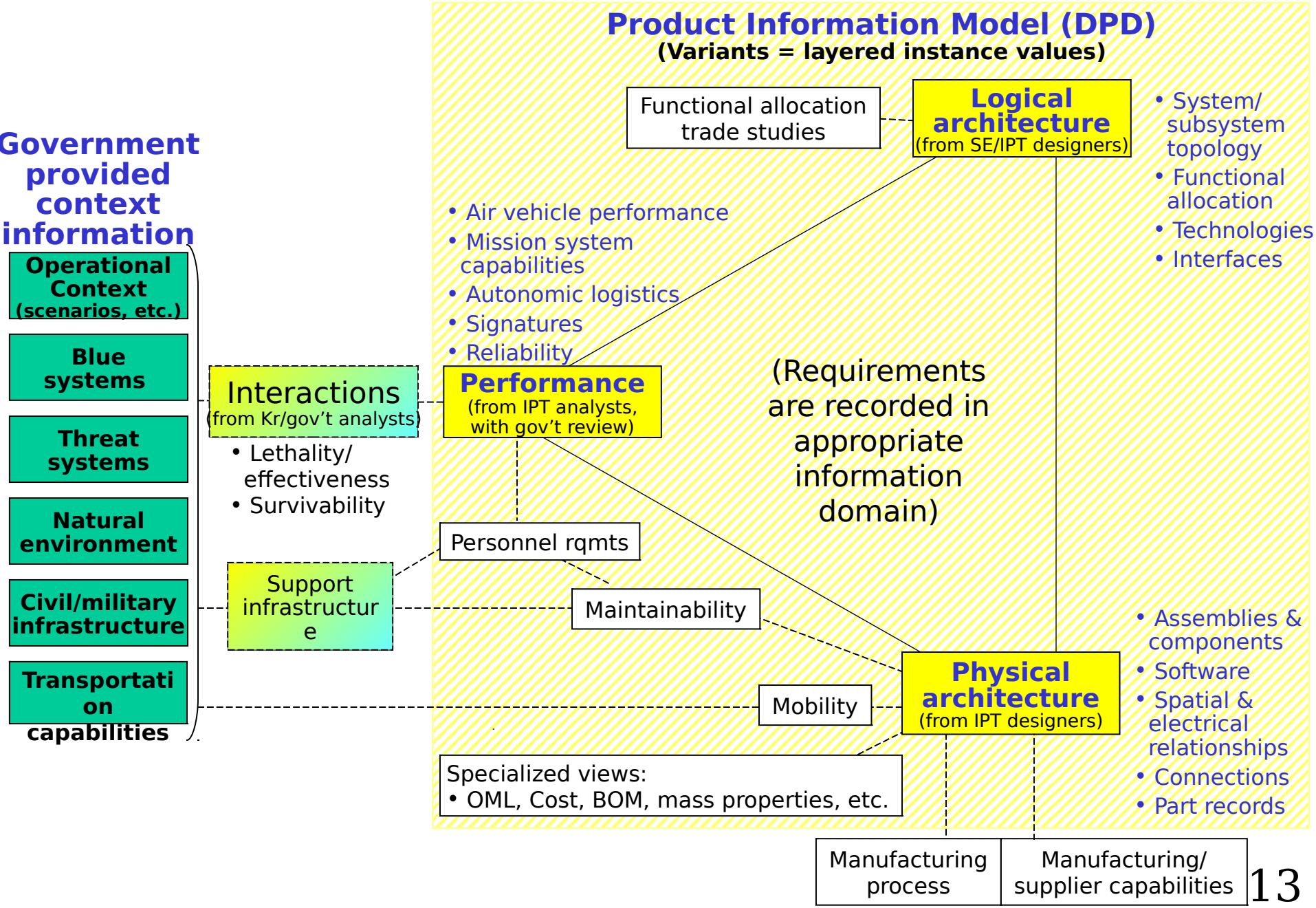
NIST study:
"Imperfect interoperability imposes at least $1B per year on the members of the U.S. automotive supply chain. By far, the greatest component of these costs is the resources devoted to repairing or reentering data files that are not reusable."

Gartner Group study:
"40% of corporate IT budgets are spent on application integration."



GartnerGroup

cope of the Product Development Information Challen



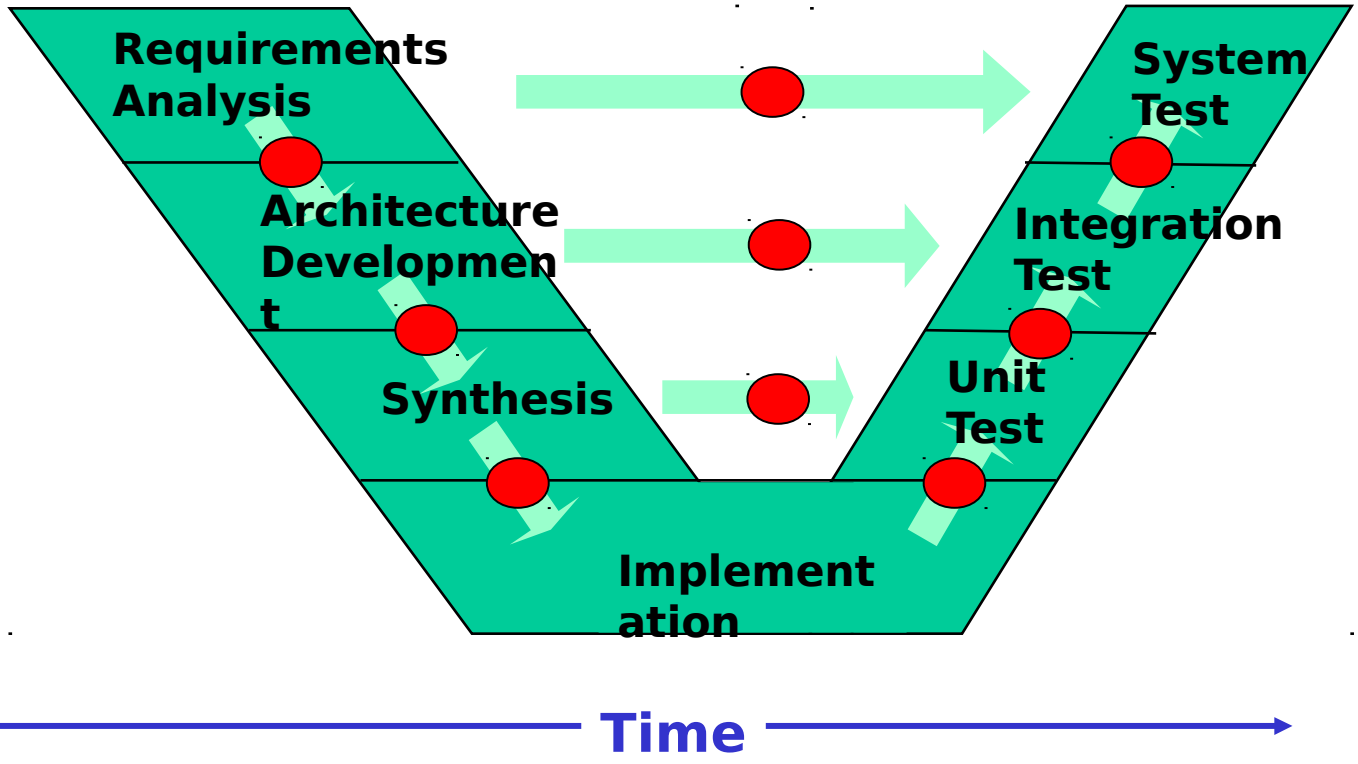
2. Countering the Fear of Exposure:
Learning to Play Well with Others

- **Must define and enforce responsibilities and liabilities for data sharing**
  - Policy guidance, contract boilerplate language
- **Establish a policy of progressive exposure that accounts for normal development/vetting process**
  - Respect an individual and organizations sensitivities until a true need-to-know exists
  - Discipline at higher levels not to over-react to preliminary info
- **Provide realistic financial compensation for data sharing**
  - A realistic business model among organizations
  - No expectation for uncompensated divestiture of 40 years of experience
- **Use an acquisition/contracting strategy that supports data sharing between government and industry**
  - An aversion to GFI means increased cost and risk

3. Fostering Understanding: Engineering the IT Infrastructure

- **Take a systems engineering approach**
  - Sharing info across an enterprise is itself a complex system
  - An architecture based approach is required, with operational, system and technical views
  - This allows logical integration of diverse database systems
- **Understanding the information flows, and where abstractions change, identifies the "hot spots"**
- **Data engineering is required for correct transformations**
- **Capturing pedigree metadata about derivation and context assumptions provides a means to foster understanding and check for coherency**
- **Web accessibility provides data visibility and an efficient distribution means**

Complex Data Exchange Needs Exist Across Organizations and Tools, Both Within and Across Phases



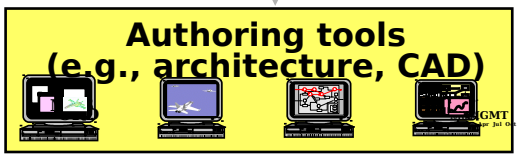
Intra-phase Problems

- Unclear data population schedule
- Data not accessible
- Data inconsistent

Inter-phase Problems

- IERs not understood
- Data not translated between lanes
- Replicated with

JSF Authoritative Modeling Information System (JAMIS) Architecture - Operational View



Register proposed designs (LM Aero)

Resource Access System (RAS)

JSF [DPD]

Interactions (P_d, P_k, etc.)

Threat & friendly systems [ASDB]

Natural environment infrastructure

Operational context

Study-specific archives

User interface admin data

Linking & translation services (mapping, semantics, syntax)

Digital System Models

Design change orders

Register design decision

JSF design change decisions

Program Offices

Blue system C&P info

Intel Centers

Threat C&P information

NIMA, DTRA, NRO, etc.

Natural environment & infrastructure C&P info

Services JFCOM, etc.

Operational context info

Register authoritative data (JSFPO)

Register smoothed / analyzed results

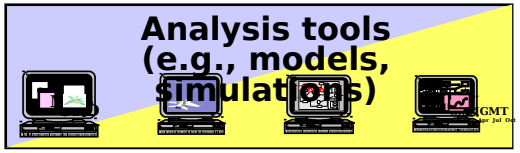
Relevant info / DSMs tool-specific formats

Design change MoMs

Analyst action

Raw M&S results

Study-specific input datasets & software code



LM Aero Team Operational Test Authorities

Register DT & OT test results

Color key:

JSFPO provided

LM Aero provide

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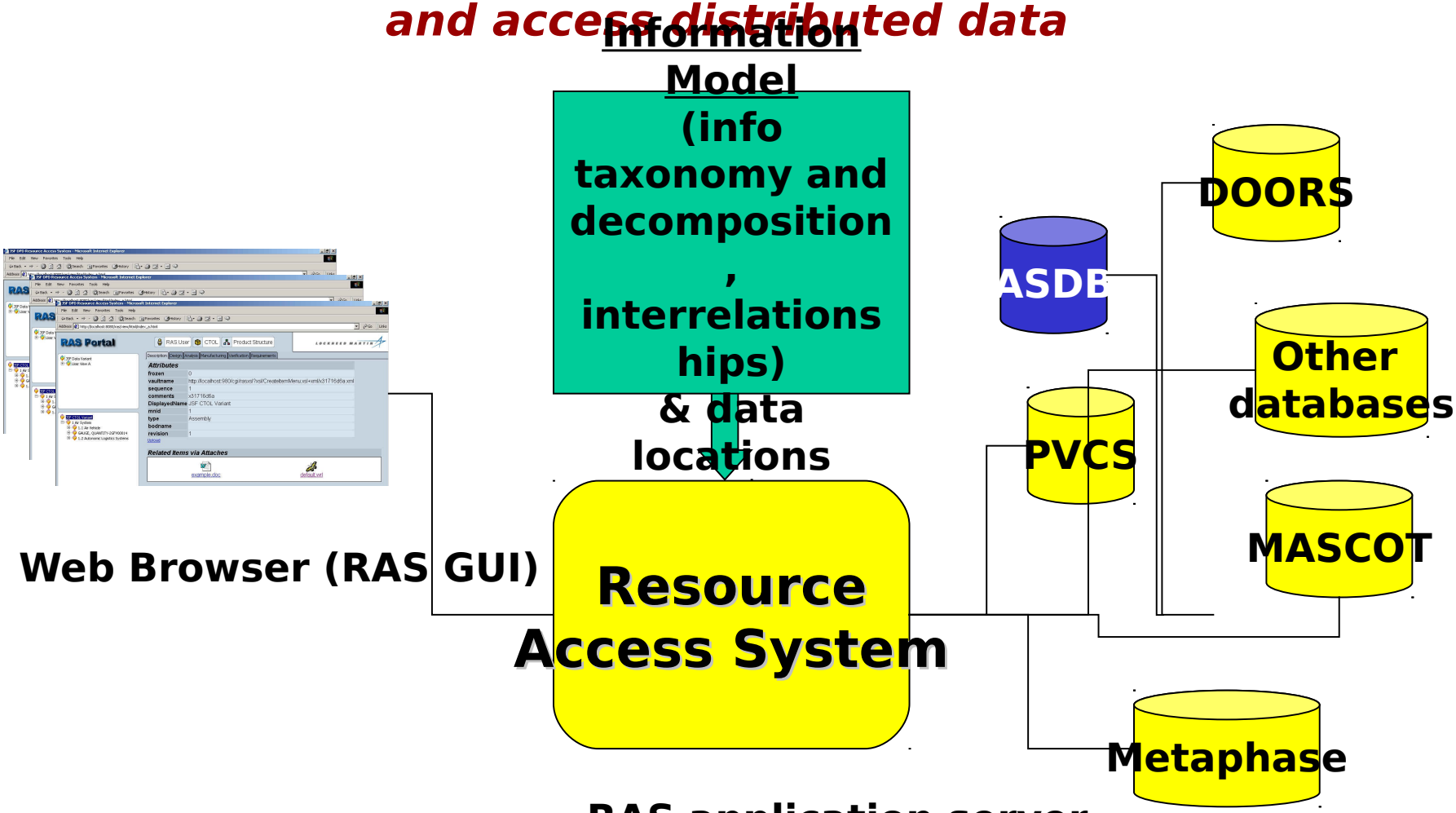
Info Model is Key to JAMIS Navigation

Information model as means to locate, navigate, and access distributed data



SBA success requires decision makers to understand the cost trades between …

duplication of effort and rework

- Many independently constructed models of same component
- Data that is incomplete, inconsistent
- Day to day costs of information acquisition activities
- Integration postponed to end, with resulting crises/rework

… and investment in

- Data engineering to understand activities, information flows, IERs and data item relationships
- Collaborative IT infrastructure to
  - Configuration manage all product development data
  - Capture and track pedigree information about data
  - Make data readily accessible for those that need it
  - Manage change
- Reusable, evolvable models and data sets that can cross swim lanes
  - Each model costs more, but fewer of them
  - More attention to integrated frameworks and standards so models and data can be reused

Summary

Progress is happening incrementally

- Imperative for accelerated capability development & delivery
- Pressure for acquisition transform
- SBA concept accepted
- Partial successes
- Technology to enable goals is maturi

Some key needs to facilitate full realization of SBA's promises

- Contracts that reflect business needs
- Data/process management policies that support product development needs
- System engineering approach to data management
- Redesigned processes to achieve business goals

"Rome was not built in one day"